MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

BTS3014 –TIME SERIES ANALYSIS AND FORECASTING

(All sections / Groups)

10 MARCH 2020
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FOUR (4)** questions on **SIX (6)** printed pages.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Write all your answers in the answer booklet provided.
4. Formula sheet is attached to the back of this question paper.

QUESTION 1

Table 1 presents the male's life expectancy at birth (years) in Malaysia from 2006 to 2017.

Table 1

Year	Life expectancy at birth, male (years)
2006	71.5
2007	71.6
2008	71.7
2009	71.9
2010	72.1
2011	72.3
2012	72.5
2013	72.7
2014	72.8
2015	73.0
2016	73.2
2017	73.3

Source: Data are obtained from World Bank, www.databank.worldbank.org.

(a) Based on **Table 1**, forecast the male's life expectancy from 2012 to 2017 using:

(i) Moving average of 2, MA (2) (3 marks)

(ii) Linear exponential smoothing (assume $\alpha = 0.6$, $\beta = 0.4$ and initial value for 2011: 72.3) (9 marks)

[*Hint: Please ensure that all the computations are accurate to* ***three decimal places***]

(b) Compute MAE and RMSE for each forecasting method in part (a). (9 marks)

(c) Based on part (b), recommend and explain a forecasting method that performs the best. Generate one-year-ahead forecast for the male's life expectancy at birth in Malaysia in Year 2018 using your recommended method. (4 marks)

[Total marks: 25 marks]

QUESTION 2

Consider the following multiple regression model for a sample of 38 emerging economies in 2018:

$$Edu_i = \beta_0 + \beta_1 GDP_i + \beta_2 Pop_i + \varepsilon_i \quad \ldots (2.1)$$

Continued...

Edu : Expenditure on education (millions of U.S. dollars)
GDP : Gross domestic product (millions of U.S. dollars)
Pop : Population (millions of people)

The results are reported in **Table 2.1**.

Table 2.1

Estimated sample countries: 38

Variable	Coefficient	Standard error	t-statistics	Probability
Constant	414.4583	266.4583	1.5538	0.1292
GDP	0.0523	0.0018	29.0556	0.0000
Pop	-10.0476	1.9992	-5.0257	0.0000

R-squared = 0.9616
F-statistic = 439.224 [*p-value*: 0.000]
Jarque-Bera test = 0.886 [*p-value*: 0.358]
Serial correlation LM test = 32.769 [*p-value*: 0.000]
White test = 53.578 [*p-value*: 0.000]

Table 2.2: Correlation Matrix

	GDP	*Pop*
GDP	1	---
Pop	0.896	1

Based on **Tables 2.1** and **2.2**, answer the following questions:

(a) Do all the explanatory variables significantly explain the expenditure on education in 38 emerging economies? Explain using F-test at $\alpha = 1\%$. (5 marks)

(b) Calculate and interpret the elasticity of expenditure on education with respect to the Gross Domestic Product (GDP), given that the expenditure on education (millions of U.S. dollars) is 110 and GDP (millions of U.S. dollars) are 1050. (6 marks)

(c) Has the estimated multiple regression model met the **FOUR (4)** assumptions underlying the method of Ordinary Least Square (OLS)? Explain your answer based on $\alpha = 5\%$. (8 marks)

(d) Generate a 95% prediction interval for the expenditure on education in an emerging economy, given *GDP* = 1500, *Pop* = 35, and the estimated standard error = 0.682. (4 marks)

(e) Is the forecast likely to be accurate? Explain based on your answer in part (c). (2 marks)

[Total marks: 25 marks]

Continued...

QUESTION 3

Table 3 presents the hypothetical time series data of sales revenue (RM million) for Company Fushiyata.

Table 3

Time	t	Sales [Y]	MA(4)	CM(4)	Detrended series
2016Q1	1	115	---	---	---
2016Q2	2	90	---	---	---
2016Q3	3	65			
2016Q4	4	135			
2017Q1	5	130			
2017Q2	6	95			
2017Q3	7	75			
2017Q4	8	150			
2018Q1	9	135			
2018Q2	10	105			
2018Q3	11	85	---	---	---
2018Q4	12	139	---	---	---

Seasonal calculations

Quarter	2016	2017	2018	Seasonal means	Adjusted means
Q1	---				
Q2	---				
Q3			---		
Q4			---		
			Total		0.000

Normalising factor = _____

Continued...

(a) Use classical additive decomposition method to calculate the detrended series and quarterly seasonal indices. (22 marks)

[*Hint: Students are required to reproduce Table 3 in the answer booklet. All the computations are to be rounded up to* ***three decimal places***]

(b) Assuming the trend in the data is $T_t = 98.5150 + 1.7541t$, where t =1 is 2016Q1 and t = 12 is 2018Q4. Prepare the company's quarterly sales revenue forecast for 2019Q1. (3 marks)

[Total: 25 marks]

QUESTION 4

(a) Describe the **THREE (3)** data available for quantitative forecasting. (6 marks)

(b) Discuss any **TWO (2)** reasons for over-reliance on judgemental approaches by many organisations in the process of forecasting. (4 marks)

(c) Explain the **FOUR (4)** steps involved in the application of a suitable ARIMA model to short-term forecasting on share price. (12 marks)

(d) Given the sample autocorrelations (AC) and the sample of partial autocorrelations (PAC) below, identify an appropriate ARMA (p, q) model for each **Figure (i)** and **(ii)**. (3 marks)

Figure (i)

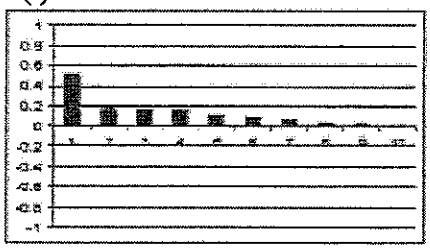
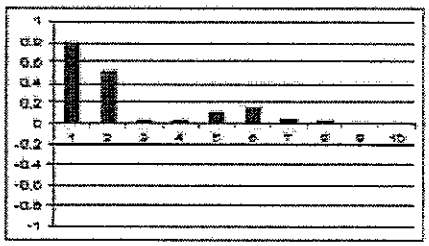
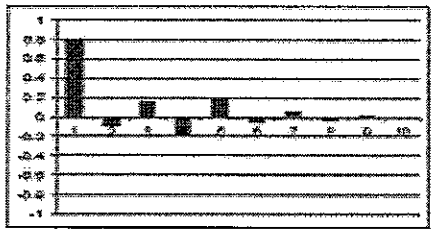
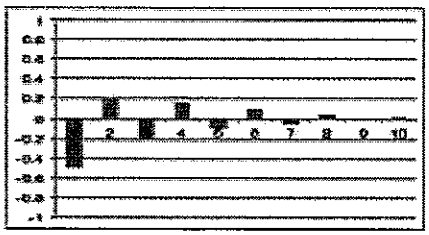
AC  PAC 

Figure (ii)

AC  PAC 

[Total marks: 25 marks]

End of Questions

Formula Sheet

Linear exponential smoothing (LES):

$$L_t = \alpha Y_t + (1-\alpha)(L_{t-1} + T_{t-1})$$

$$T_t = \beta(L_t - L_{t-1}) + (1-\beta)T_{t-1}$$

$$\hat{Y}_{t+p} = L_t + pT_t$$

Moving Average:

$$\hat{Y}_{t+1} = \frac{Y_t + Y_{t-1} + \ldots + Y_{t-K+1}}{K}$$

Mean Absolute Error (MAE) $= \frac{1}{n}\sum_{i=1}^{n}\left|Y_{t+i} - F_{t+i}\right|$

Mean Square Error (MSE) $= \frac{1}{n}\sum_{i=1}^{n}\left(Y_{t+i} - F_{t+i}\right)^2$

Root Mean Square Error (RMSE) $= \sqrt{MSE}$

$$Elasticity = b_1\left(\frac{X}{Y}\right)$$

Time series additive decomposition

$$Y_t = T_t + C_t + S_t + \varepsilon_t$$

Time series multiplicative decomposition

$$Y_t = T_t * C_t * S_t * \varepsilon_t$$

AR process: p-order autoregressive model

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \ldots + \gamma_p Y_{t-p} + \varepsilon_t$$

MA process: q-order moving average model

$$Y_t = \theta_0 + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \ldots - \theta_q\varepsilon_{t-q}$$

Regression model:

$$t - statistic = \frac{\hat{\beta} - \beta}{se(\hat{\beta})}$$

Prediction interval = $F_{t+1} \pm (t_{\alpha/2,n-K-1}) * SE$

Summary of *t*-distribution:

df \ Pr	**0.05 0.10**	**0.025 0.05**	**0.005 0.010**
40	1.684	2.021	2.704
60	1.671	2.000	2.660
120	1.658	1.890	2.617
∞	1.645	1.960	2.576

End of Paper